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Courses » **Engineering Mechanics** Announcements **Course** Ask a Question Progress Mentor

Unit 11 - Week 10 Lectures

Course outline

Assignment 10

The due date for submitting this assignment has passed. **Due on 2016-09-28, 23:59 IST.**

Submitted assignment

1) A person of mass 50 kg is on a swing of length 6 m that is moving with an amplitude of 2 m. ***1 point***
To a good approximation, the motion of the swing can be treated as simple harmonic. Another person standing on the ground hands him a child (mass 10 kg) who wants to sits with the person on the swing. Assume the velocity of the child when the person on the swing holds her in negligible. The new amplitude of the swing when the child is handed over at extreme position is :

- 4 m
- 3 m
- 2 m
- 6 m

No, the answer is incorrect.
Score: 0

Accepted Answers:
2 m

2) A rigid rod of length *l* and mass *m* is pivoted at one end and is oscillating in the vertical plane ***1 point***
with a small amplitude. The frequency of the oscillation will be :

- $\omega = \sqrt{\frac{5g}{2l}}$
- $\omega = \sqrt{\frac{7g}{3l}}$
- $\omega = \sqrt{\frac{3g}{2l}}$
- $\omega = \sqrt{\frac{11g}{5l}}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$\omega = \sqrt{\frac{3g}{2l}}$

3) ***1 point***

It is known result of electromagnetic theory that an accelerating electron radiates energy. Suppose an electron is attached to a spring , so that it oscillates with a frequency ω ans its displacement is given as $x(t) = A\cos\ (\omega\ t)$. The rate of radiation from such an electron at time t is given by $\frac{dE}{dt} = \frac{\omega^4 e^2 A^2}{6\pi\epsilon_0 c^3}\cos^2\ \omega\ t$ Here e is the electronic charge , c is the speed of light and ϵ_0 is permittivity of vacum. The Quality factor of such an oscillator is

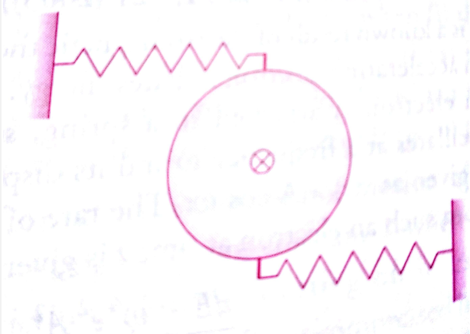
- $\frac{\omega^2 e^2}{18\pi\epsilon_0 m_e c^3}$
- $\frac{\omega^2 e^2}{8\pi\epsilon_0 m_e c^3}$
- $\frac{\omega^2 e^2}{6\pi\epsilon_0 m_e c^3}$
- $\frac{\omega^2 e^2}{24\pi\epsilon_0 m_e c^3}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$\frac{\omega^2 e^2}{6\pi\epsilon_0 m_e c^3}$

4) A horizontal disc of mass 2 kg free to rotate about it's center is connected to two springs as shown in the figure. If the spring constant of both the springs is 500 N/m, the angular frequency of the disc when rotated slightly from its equilibrium position and then released is close to ***1 point***



- 6.3 rad/s
- 15.7 rad/s
- 31.4 rad/s
- 62.8 rad/s

No, the answer is incorrect.
Score: 0

Accepted Answers:
31.4 rad/s

5) A horizontal spring-mass oscillator has the mass oscillating on a table with the frictional coefficient between the mass and the table being close to 0.1 (both kinetic and static). The natural frequency of the oscillator is 10 Hz. The system is given initial amplitude of 0.2 m. The total distance traveled by the mass before it comes to stop is close to (take g= 9.8 ms^{-2}) ***1 point***

- 20 m
- 40 m
- 80 m
- 160 m

No, the answer is incorrect.
Score: 0

Accepted Answers:
80 m

6) When an assumed solution of the form $e^{\lambda t}$ is substituted in the equation of motion for a damped harmonic oscillator, the roots of the resulting quadratic equation are -1.1$\pm$ 4.87 i where $i = \sqrt{-1}$. The natural frequency of the oscillator without any damping is **1 point**

- 4.9 rads^{-1}|
- 5.0 rads^{-1}|
- 5.2rads^{-1}
- 5.3rads^{-1}

No, the answer is incorrect.
Score: 0

Accepted Answers:
5.0 rads^{-1}|

7) A spring-mass system is to be connected with a damper that exerts a velocity dependent force *F* = -*bv* with b = 7 Nsm^{-1}. If the mass attached to the spring is 2 kg, value of the spring constant so that the system is critically damped is **1 point**

- 49 Nm^{-1}
- 24.5 Nm^{-1}
- 12.25 Nm^{-1}
- 6.125 Nm^{-1}

No, the answer is incorrect.
Score: 0

Accepted Answers:
6.125 Nm^{-1}

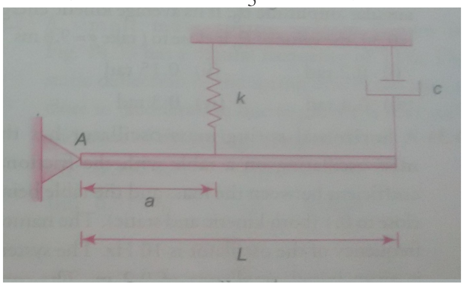
8) For a critically damped spring-mass-damper system with the coefficient of velocity dependent force b=4 Nsm^{-1} and the spring constant k=16 N m^{-1}, the mass of the system is **1 point**

- 0.5 kg
- 0.25 kg
- 4 kg
- 2 kg

No, the answer is incorrect.
Score: 0

Accepted Answers:
0.25 kg

9) A uniform rigid bar of mass *m*=1 kg and length *L*=1 m is pivoted at A. It is supported by a stiffness *k*=1 N ms^{-1} and viscous damper of damping constant *C*=1 N ms^{-1}, with $a = \frac{1}{\sqrt{3}}$ m as shown in figure. The moment of inertia of the rigid bar is $I_A = \frac{mL^2}{3}$. The system is **1 point**



Overdamped

Underdamped with natural frequency $\omega_0 \simeq 1.3 rads^{-1}$

Critically damped

Underdamped with natural frequency $\omega_0 \simeq 1.7 rads^{-1}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
Overdamped

10) A lightly damped spring-mass oscillator is such that in 50 complete periods, its amplitude decreases by a factor of 4. To make it critically damped, the coefficient *b* of the damping force *F=-bv* and the mass m are changed. If b is increased by a factor of 150, the new mass should be about ***1 point***

0.2 m

0.4 m

2.5 m

0.5 m

No, the answer is incorrect.
Score: 0

Accepted Answers:
0.4 m

11) Quality factor of a lightly damped oscillator is 100. In *N* cycles, its amplitude reduces roughly by a factor of 2. Then ***1 point***

N=13

N=18

N=23

N=27

No, the answer is incorrect.
Score: 0

Accepted Answers:
N=23

12) The logarithmic decrement δ is defined to be the natural logarithm of the ratio of successive maximum displacements (in the same direction) of a free damped oscillator. If Q be the quality factor, then ***1 point***

$\delta = \frac{\pi}{2Q}$

$\delta = \frac{\pi}{Q}$

$\delta = \frac{2\pi}{Q}$

$\delta = \frac{Q}{\pi}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$\delta = \frac{\pi}{Q}$

13) ***1 point***

The pendulum of a grandfather clock activates an escapement mechanism every time it passes through the vertical. The escapement is under tension (provided by a hanging weight) and gives the pendulum a small impulse a distance l from the pivot. The energy transferred by this impulse compensates for the energy dissipated by friction, so that the pendulum swings with a constant amplitude. Which of the following is the impulse needed to sustain the motion of a pendulum of length L and mass m, with an amplitude of swing θ_0 and quality factor Q?

- $\frac{\pi\theta_0}{2Q}\, m\sqrt{gL}$
- $\frac{\pi\theta_0}{Q}\, m\sqrt{gL}$
- $\frac{2\pi\theta_0}{Q}\, m\sqrt{gL}$
- $\frac{\pi\theta_0}{Q}\, m\sqrt{2gL}$

No, the answer is incorrect.
Score: 0

Accepted Answers:

$\frac{\pi\theta_0}{2Q}\, m\sqrt{gL}$

14) A small cuckoo clock has a pendulum 25 cm long with a massof 10 g and a period of 1 s. ***1 point***
The clock is powered by a 200-gramweight which falls 2 m between the daily windings. The amplitude of the swing is 0.2 rad. Which of the following is the Q of the clock?

- 17
- 34
- 68
- 136

No, the answer is incorrect.
Score: 0

Accepted Answers:
68

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